

CLAIMS

What is claimed is:

- 1 1. A method of decomposing an image comprising the steps of:
  - 2 a) decomposing the image into a plurality of stripes;
  - 3 b) decomposing each stripe into foreground and background
  - 4 image layers, and a mask layer; and
  - 5 c) applying a smoothing filter to interpolate irrelevant pixel
  - 6 values in the foreground and background layers for wavelet encoding
  - 7 efficiency.
- 1 2. The method of claim 1 further comprising the step of:
  - 2 d) encoding the foreground, background, and mask layers with a
  - 3 forward discrete wavelet transformation encoder.
- 1 3. The method of claim 2 wherein the foreground and background are
- 2 JPEG 2000 encoded, wherein the mask is encoded with one of a JBIG and a
- 3 JBIG2 encoder.
- 1 4. The method of claim 1 wherein step c) further comprises the steps
- 2 of:
  - 3 i) determining a layer base color and offsets to a common
  - 4 reduced area of each layer to identify image and mask layer values for all
  - 5 regions except an overlapped common reduced area; and
  - 6 ii) separating the overlapped common reduced area into
  - 7 foreground and background layers.
- 1 5. The method of claim 1 wherein step c) further comprises the steps:
  - 2 i) classifying each pixel within a selected layer as relevant or
  - 3 irrelevant; and

4           ii)     applying a smoothing filter to each irrelevant pixel,  $p_c$ ,  
5     proceeding in a raster scan order to interpolate a value for that irrelevant  
6     pixel.

1     6.     The method of claim 5 wherein a normalized weighted average of  
2     the relevant pixels and the causal irrelevant pixels contribute to the  
3     interpolated value.

1     7.     The method of claim 5 wherein the smoothing filter is a weighted  
2     Gaussian filter.

1     8.     The method of claim 7 wherein each element of the smoothing  
2     filter is of the form  $w_{kl}V_{kl}$ , wherein  $V_{kl}$  is a non-weighted filter value,  
3     wherein  $w_{kl}$  is a function of its associated pixel causality and relevance.

1     9.     The method of claim 8 wherein  $w_{kl} = 0$  for the center pixel ( $p_c$ ) and  
2     any non-causal irrelevant pixel.

1     10.    The method of claim 8 wherein  $w_{kl} = m_1$  if its associated pixel is a  
2     relevant pixel, wherein  $w_{kl} = m_2$  if the associated pixel is a causal irrelevant  
3     pixel.

1     11.    The method of claim 10 wherein  $\frac{m_1}{m_2} > 1$ .

1     12.    The method of claim 10 wherein  $\frac{m_1}{m_2} = 2$ .

1 13. The method of claim 1 wherein step b) further comprises the steps  
2 of:

3 i) dividing a selected layer into a plurality of decision regions  
4 ( $D_{ij}$ ) and associated analysis regions ( $A_{ij}$ ), wherein each  $D_{ij} \subseteq A_{ij}$ ; and

5 ii) assigning the entire region  $D_{ij}$  to one of the background and  
6 foreground layers, if a contrast of  $A_{ij}$  does not exceed a pre-determined  
7 threshold.

1 14. The method of claim 13 wherein the entire region  $D_{ij}$  is assigned to  
2 the foreground or background layers based on whether the average pixel  
3 value  $AVG(D_{ij})$  is closer to an average pixel value of neighboring  
4 foreground regions or neighboring background regions.

1 15. The method of claim 1 wherein step b) further comprises the steps  
2 of:

3 i) dividing a selected layer into a plurality of decision regions  
4 ( $D_{ij}$ ) and associated analysis regions ( $A_{ij}$ ), wherein each  $D_{ij} \subseteq A_{ij}$ ; and

5 ii) distributing the pixels of  $D_{ij}$  between the background and  
6 foreground layers, if a contrast of  $A_{ij}$  exceeds a pre-determined threshold.

1 16. The method of claim 15, wherein step b)(ii) further comprises the  
2 steps of:

3 i) separating the pixels of  $A_{ij}$  into two groups, GROUP\_1 and  
4 GROUP\_2;

5 ii) compute an average ( $AVG_1$ ,  $AVG_2$ ) for each group; and

6 iii) mutually exclusively assigning the pixels of  $D_{ij}$  in GROUP\_1  
7 and GROUP\_2 to a selected one of the foreground and background layers  
8 based on a comparison of the relative luminance of GROUP\_1 and  
9 GROUP\_2.

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1 17. A method of preparing an image for efficient wavelet transform  
2 compression, comprising the steps of:

3 a) separating the image into foreground and background image  
4 layers, and a mask layer; and

5 b) applying a smoothing filter to interpolate irrelevant pixel  
6 values in the foreground and background layers for coder efficiency.

1 18. The method of claim 17 wherein a normalized weighted average of  
2 the relevant pixels and the causal irrelevant pixels contribute to the  
3 interpolated value.

1 19. The method of claim 17 wherein the smoothing filter is a weighted  
2 Gaussian filter.

1 20. The method of claim 17 wherein each element of the smoothing  
2 filter is of the form  $w_{kl}V_{kl}$ , wherein  $V_{kl}$  is a non-weighted filter value,  
3 wherein  $w_{kl}$  is a function of its associated pixel causality and relevance.

1 21. The method of claim 20 wherein  $w_{kl} = 0$  for the center pixel ( $p_c$ ) and  
2 any non-causal irrelevant pixel.

1 22. The method of claim 20 wherein  $w_{kl} = m_1$  if its associated pixel is a  
2 relevant pixel, wherein  $w_{kl} = m_2$  if the associated pixel is a causal irrelevant  
3 pixel.

1 23. The method of claim 22 wherein  $\frac{m_1}{m_2} > 1$ .

- 1 24. The method of claim 22 wherein  $\frac{m_1}{m_2} = 2$ .

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